# Hydrogen Deficient Carbon-Rich Supergiant Stars: Tracing their Atmosphere Rich in Oxygen-18 Isotope to their White-Dwarf Merger Origin

Patrick Tisserand[1]

[1] Institut d'Astrophysique de Paris, F-75014 Paris, France

Hydrogen-deficient Carbon (HdC) stars are supergiants characterised by highly unusual chemical compositions, believed to result from mergers between carbon-oxygen (CO) and helium (He) white dwarfs. Following an overview of our current understanding of these enigmatic and rare stars - whose first known example, R CrB, was discovered over 200 years ago - I will present our latest findings. In a recent study, Mehla et al. (2025) analysed high-resolution K-band spectra (R $\sim$ 75,000) of six R Coronae Borealis (RCB) stars and six dustless Hydrogen-deficient Carbon (dL-HdC) stars. These two subgroups of HdC stars are thought to represent the high- and low-mass ends, respectively, of the CO-He white dwarf merger population. A semi-automated fitting routine was developed to measure oxygen $^{16}O/^{18}O$ isotope ratios using the latest ExoMol line lists. It revealed that all dLHdC stars have ratios consistently lower than 1, while RCB stars exhibit ratios above 4. Notably, a trend of decreasing $^{16}O/^{18}O$ ratios with increasing effective temperature was observed, aligning with theoretical predictions of white dwarf merger models, although current models overpredict the low $^{16}O/^{18}O$ ratios in dLHdC stars by two orders of magnitude. Additionally, abundances analysis uncovered a correlation between $^{14}N$ and $^{18}O$ abundances, suggesting $\alpha$-capture processes converting a fixed fraction of $^{14}N$ to $^{18}O$ from partial He-burning occurring during the merger phase. We are currently extending this work with the analysis of over 30 high-resolution optical spectra of HdC stars obtained using the AAT/VELOCE spectrograph - representing the largest such sample studied to date.